Centripetal Acceleration Lab

SPH4U Lab # 5

Procedure:

1. Get a rubber stopper, a straw and 50, 100. 150. 200 and 250 g masses .

2. Measure and record the mass of your rubber stopper. Tie the stopper to one end of the cord. Pass the other end of the cord through the straw and attach a 50.0 g mass hanger. Tie a knot in the cord so that it will be a short distance below the end of the straw when the stopper is being whirled above your head in a horizontal circle of approximately 70 cm radius. Measure and record the resulting exact radius. (Measure from the top of the straw to the stopper's center of mass.)

3. Practice whirling the stopper in a circular horizontal path above your head. The stopper is traveling at the desired speed when it maintains its circular path with the string knot in its proper position. If the knot starts to fall, the stopper's speed is too slow and if the knot starts to rise, you are whirling it too fast.

4. When you have the stopper moving with the desired speed, count aloud so your partner can time a convenient number of revolutions. (Engage brain: Remember to start counting and timing with revolution number zero!) Record the number of revolutions and the time they took in a data table. Also, record the mass hanging on the end of the cord.

5. Using the time and number of revolutions from step 3 and the exact radius from step 1, compute the linear velocity (v) of the stopper and record it in the table. (Remember?? v=d/t. Ah, but what is d and what is t??)

6. Repeat steps 3 and 4 for masses of 100, 150, 200, and 250 g hanging on the end of the cord. The force of gravity pulling on these masses, puts a tension in the cord which pulls on the stopper. This ***is the centripetal force*** (F_c). Put that in the table for each trial, too.

Analysis:

1. Construct a graph of centripetal force (F_c) vs. stopper velocity (v). (Plot F_c on the y axis; it violates convention, but there's a reason.) What does the plot look like? What does this suggest?

2. Modify (manipulate) the data in order to get a straight line graph. Try all sorts of buttons on your calculator until, say, 4 data points, form a straight line. What did you have to do? What does this say about the relationship between centripetal force and velocity?

3. This is an accepted formula for computing the centripetal force required to keep an object in a circular path. For each of your trials calculate this F_c and add it to your table. Since F_g on the weights gives a known F_c and formulas never lie, why the differences between the two F_c's? How different are they? Which should be the accepted value when comparing? Why? $F_c = \frac{mv^2}{r}$

4. Referring to the formula above, what should the slope of your modified graph be? How close was yours?